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The Maastrichtian Ammonites *Coahuilites sheltoni* Böse, 1928, and *Sphenodiscus pleurisepta* (Conrad, 1857), from the Uppermost Pierre Shale and Basal Fox Hills Formation of Colorado and Wyoming

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ABSTRACT

The Maastrichtian ammonites *Coahuilites sheltoni* Böse, 1928, and *Sphenodiscus pleurisepta* (Conrad, 1857), are described from the Western Interior where they are rare tethyan immigrants from Trans-Pecos Texas and adjacent parts of Mexico. *C. sheltoni* occurs in the *Hoploscaphites*

birkelundi zone of Niobrara County, Wyoming, and Weld County, Colorado. *S. pleurisepta* occurs in the *H. birkelundi* zone of Niobrara County, Wyoming; Weld County, Colorado; and Meade and Pennington counties, South Dakota.

INTRODUCTION

Sphenodiscid ammonites dominate the ammonite faunas of the Escondido Formation and its correlatives in Trans-Pecos Texas and adjacent parts of Mexico, and are also known from other parts of the Gulf Coast and Atlantic Seaboard as far north as New Jersey. However, only three species are

known from the Western Interior: *Sphenodiscus lobatus* (Tuomey, 1856), *Sphenodiscus pleurisepta* (Conrad, 1857), and *Coahuilites sheltoni* Böse, 1928.

The most common species in the Western Interior is *Sphenodiscus lobatus*. Examples of this species are illustrated in Meek (1876:

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ZONE \ SPECIES			
	<i>C.sheltoni</i>	<i>S.pleurisepta</i>	<i>S.lobatus</i>
<i>Jeletzkytes nebrascensis</i>			*
<i>Hoploscaphites nicolletii</i>			*
<i>Hoploscaphites birkelundi</i>	*	*	?

Fig. 1. Zonal distribution of species of *Coahuilites* and *Sphenodiscus* in the Maastrichtian of the northern part of the Western Interior.

473, pl. 34, fig. 1, text-fig. 66) and Hyatt (1903: 66, pl. 8, figs. 1–7). It occurs in the *Hoploscaphites nicolletii* and *Jeletzkytes nebrascensis* zones of the Fox Hills Formation in north-central South Dakota (fig. 1; Landman and Waage, 1993). It has also been tentatively identified from the *Hoploscaphites birkelundi* zone of the Fox Hills Formation

in Niobrara County, Wyoming (fig. 1). Outside the Western Interior, this species occurs in the Prairie Bluff Chalk in Alabama and Mississippi; the Escondido Formation in Trans-Pecos Texas and northern Mexico; the Corsicana Formation in northeast Texas; the upper part of the Ripley Formation in Mississippi; the Providence Sand in eastern Alabama; the Peedee Formation in North Carolina; the Severn Formation in Maryland; the Red Bank Sand and Tinton Sand in New Jersey; Israel; and Nigeria.

Sphenodiscus lobatus has had an interesting nomenclatural history. It was the first species of Sphenodiscidae described from the United States, and was based on a specimen that probably came from the Fox Hills Formation of north-central South Dakota. It was described by Owen (1852: 579, pl. 8, fig. 5)

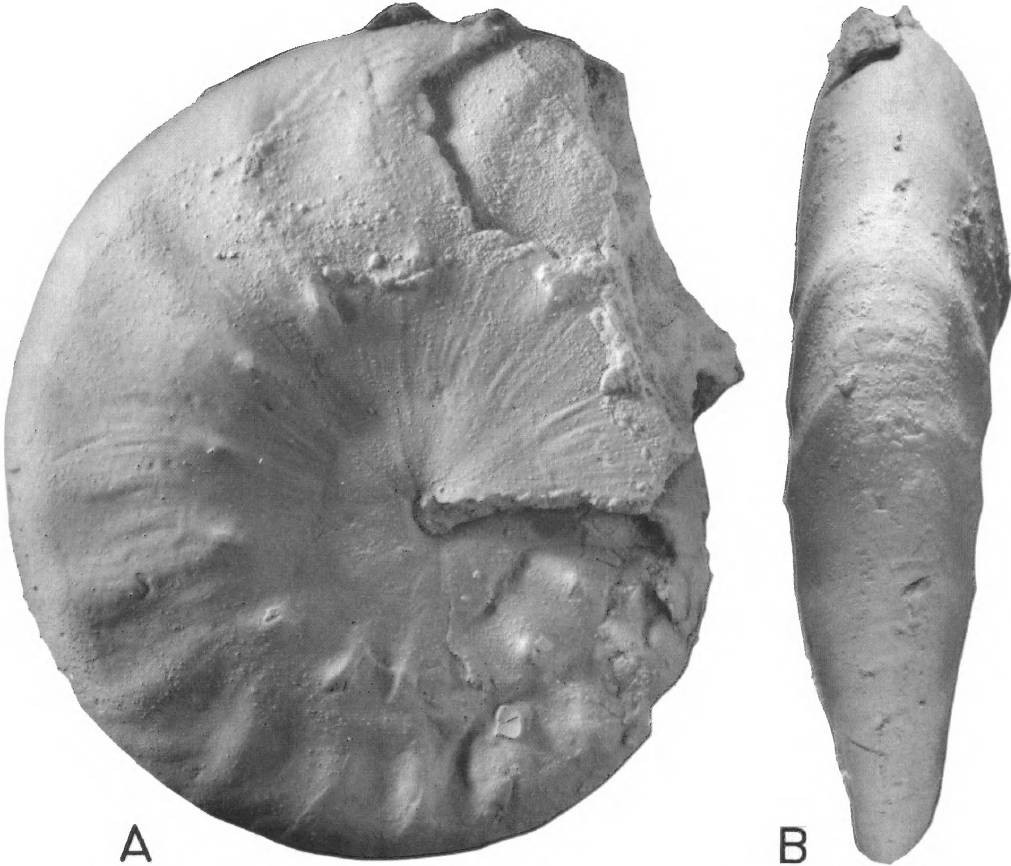


Fig. 2. *Coahuilites sheltoni* Böse, 1928, USNM 76260 from the Milliken Sandstone Member of the Fox Hills Formation in sec. 6, T7N, R66W, Weld County, Colorado. **A**, Left lateral; **B**, ventral. A body chamber is present but it is not possible to pinpoint the base. All figures are $\times 1$.

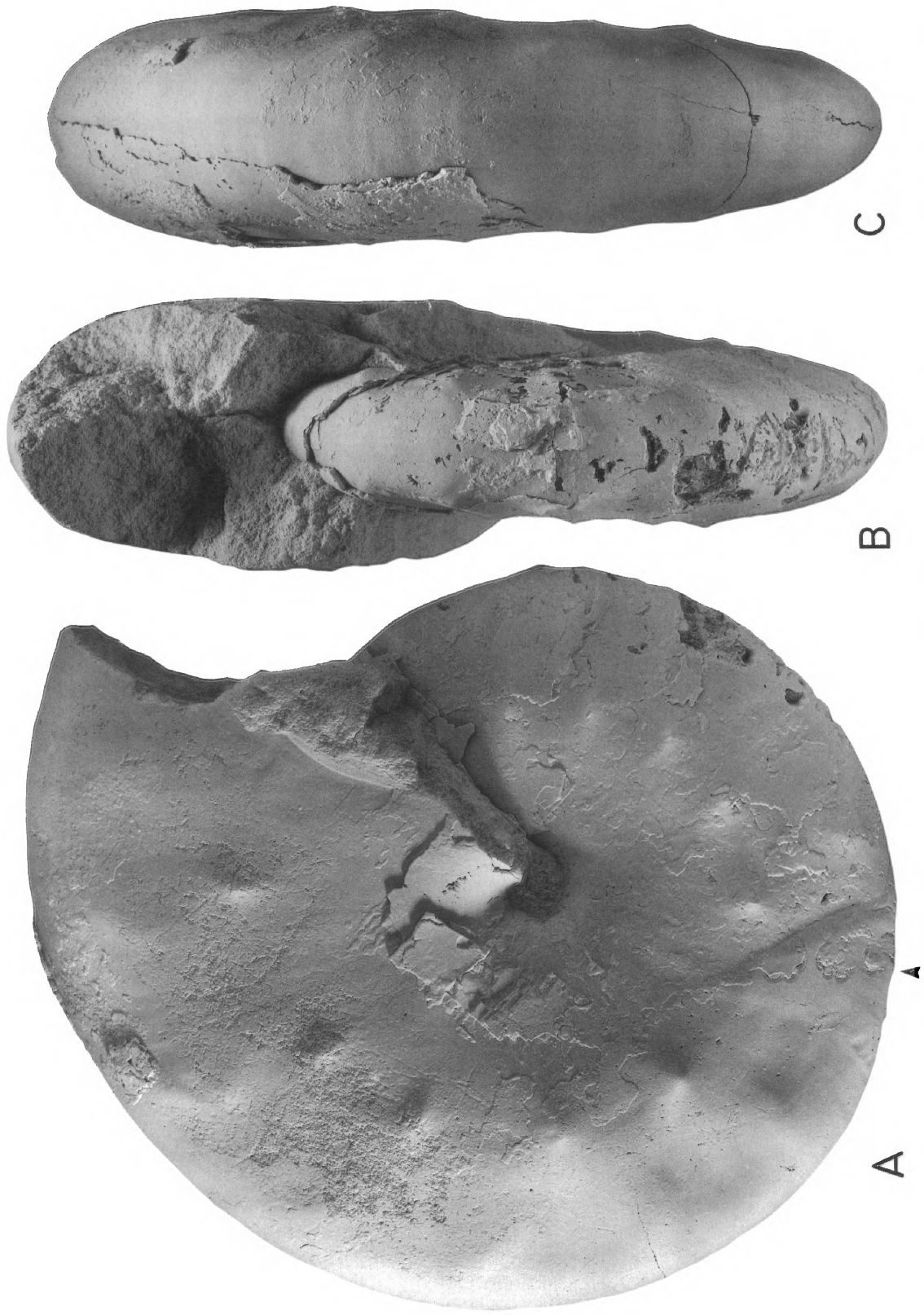


Fig. 3. *Coduillites sheltoni* Böse, 1928, USNM 32152 from the Fox Hills Formation, Niobrara County, Wyoming. A, Left lateral; B, apertural; C, ventral. All figures are $\times 1$.

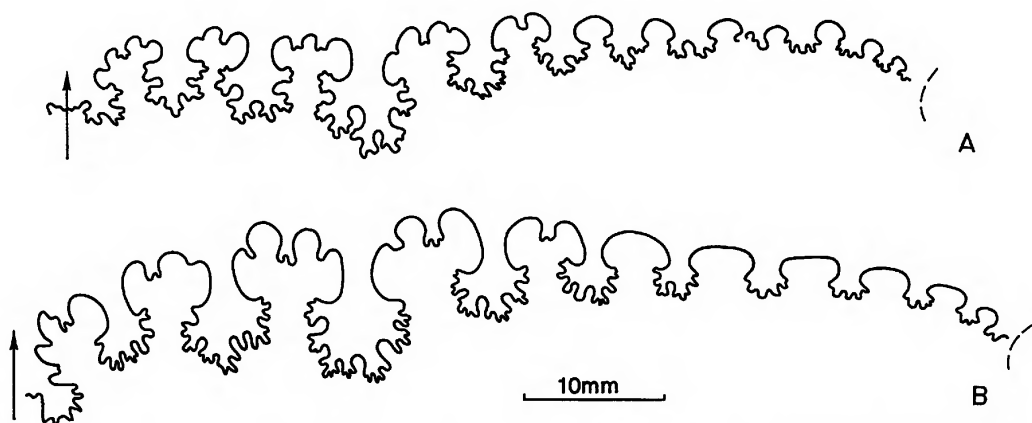


Fig. 4. External sutures. **A.** *Sphenodiscus pleurisepta* (Conrad, 1857), USNM 486637, USGS Mesozoic loc. 5981. **B.** *Coahuilites sheltoni* Böse, 1928, USNM 32152 from the Fox Hills Formation, Niobrara County, Wyoming.

who called it *Ammonites lenticularis* unaware that Young and Bird (1828: 269, fig. 5; see also Phillips, 1829: pl. 6, fig. 5) had already used this name 24 years earlier to describe another ammonite species. Thus, due to homonymy, the name *A. lenticularis* was preoccupied. In 1856, Tuomey (p. 168) described *Ammonites lobata* based on a specimen from Mississippi, without providing an illustration. Meek (1871: 298) referred *Ammonites lobata* to *Ammonites (Sphenodiscus)* and modified the specific name to *lobatus*. He later (1876: 473) synonymized it with *Sphenodiscus lenticularis* (Owen) (see also Wright, 1957: L437; Zaborski, 1982: 315, 316; Cobban and Kennedy, 1995: 12). We provisionally follow this synonymy here. However, the holotype of *S. lobatus* (Tuomey) is believed to be lost and Stephenson (1941: 434) designated a neotype (USNM 2403) (the specimen figured by Hyatt, 1903: pl. 7, figs. 1, 2). Because of the possibility of confusion, we feel it is important in the future to demonstrate, on the basis of the rich sphenodiscid material from the Fox Hills

Formation of north-central South Dakota, that *S. lobatus* (Tuomey) is, in fact, conspecific with *S. lenticularis* (Owen). Further discussion of this problem is deferred to another paper.

Two other sphenodiscids, *Coahuilites sheltoni* Böse, 1928, and *Sphenodiscus pleurisepta* (Conrad, 1857), are widespread in the United States outside the Western Interior, but only occur as short-lived rarities in this basin. *C. sheltoni* occurs in the *Hoploscaphites birkelundi* zone of Niobrara County, Wyoming, and Weld County, Colorado. *S. pleurisepta* occurs in the *H. birkelundi* zone of Niobrara County, Wyoming; Weld County, Colorado; and Meade and Pennington counties, South Dakota.

CONVENTIONS

Institutional abbreviations are:

USNM (U.S. National Museum of Natural History, Washington, D.C.), AMNH (American Museum of Natural History), and BHI (Black Hills Museum of Natural History, Hill City, SD). Su-

TABLE 1
Dimensions (mm) of *Coahuilites sheltoni* Böse, 1928^a

Specimen	D	Wb	Wh	Wb:Wh	U
USNM 76260	111.0 (100)	26.9 (24.3)	63.4 (57.1)	0.42	4.6 (4.2)
USNM 32152	149.0 (100)	41.2 (27.6)	82.7 (55.5)	0.50	11.3 (7.6)

^a Figures in parentheses are dimensions as a percentage of diameter.

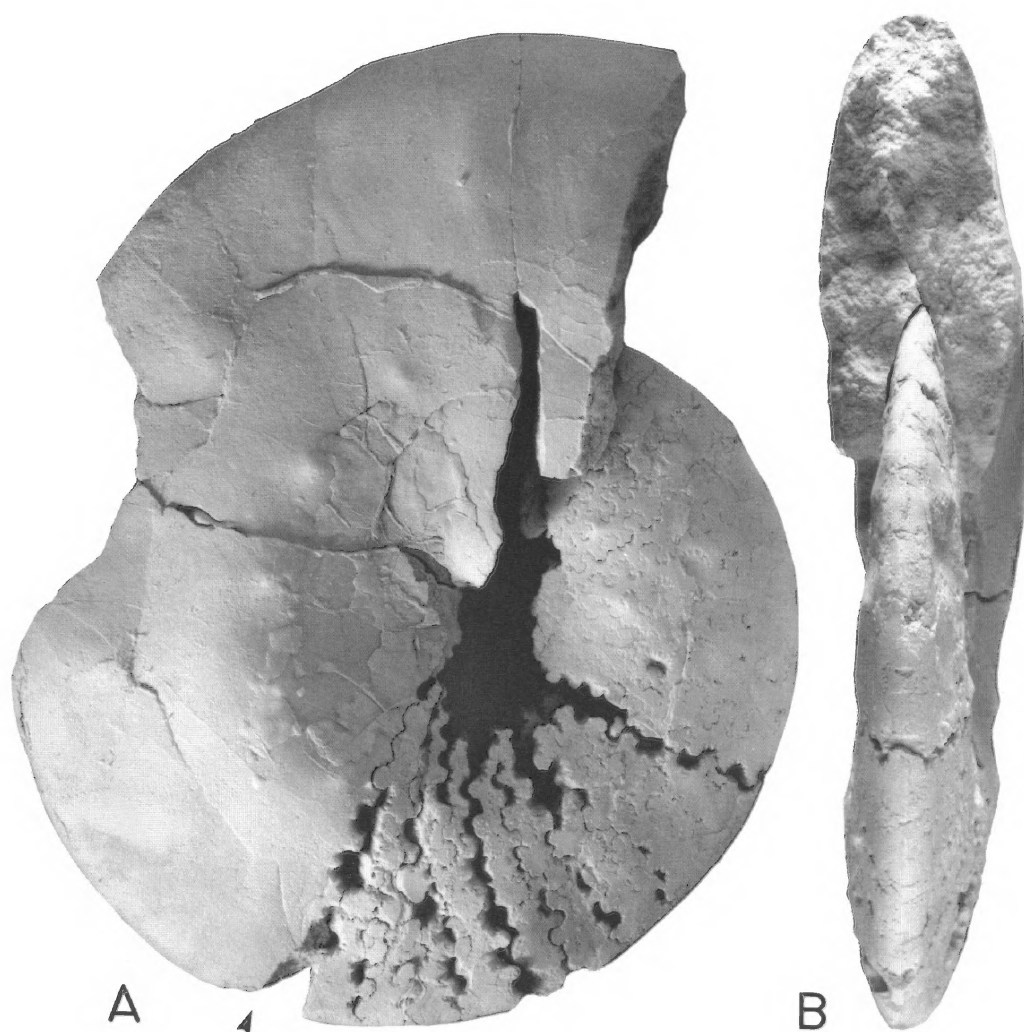


Fig. 5. *Sphenodiscus pleurisepta* (Conrad, 1857), USNM 486640, presumably a microconch, USGS Mesozoic loc. D12236. **A**, Left lateral; **B**, apertural. All figures are $\times 1$.

ture terminology is that of Kullman and Wiedmann (1970): E = external lobe, L = lateral lobe, U = umbilical lobe, and I = internal lobe. Dimensions are expressed in millimeters, where D = diameter, Wb = whorl breadth, Wh = whorl height, and U = umbilical diameter. Arrows indicate the base of the body chamber. Figures in parentheses are dimensions as a percentage of diameter. Specimens are photographed in the conventional position with the aperture on top although the authors recognize that the animal would have been oriented differently in life.

LOCALITIES

The following localities are mentioned in the text:

USGS Mesozoic locality 5981, Fox Hills Formation, Lance Creek, near its mouth into the Cheyenne River, Niobrara County, Wyoming.

USGS Mesozoic locality 22116, basal part of the Fox Hills Formation, *Hoploscaphites birkelundi* zone, northeast of Red Bird, in the SE $\frac{1}{4}$ sec. 22, T38N, R62W, Niobrara County, Wyoming.

USGS Mesozoic locality D1049, brown sandstone concretions about 145 ft above the base of the Fox Hills Formation, about 1 mi southeast of U.S. Highway 85, in the NW $\frac{1}{4}$ sec. 25, T39N, R62W, Niobrara County, Wyoming.

USGS Mesozoic locality D12236, Milliken Sandstone Member of the Fox Hills Formation, north bank of the St. Vrain River, in the SE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 8, T2N, R68W, Weld County, Colorado.

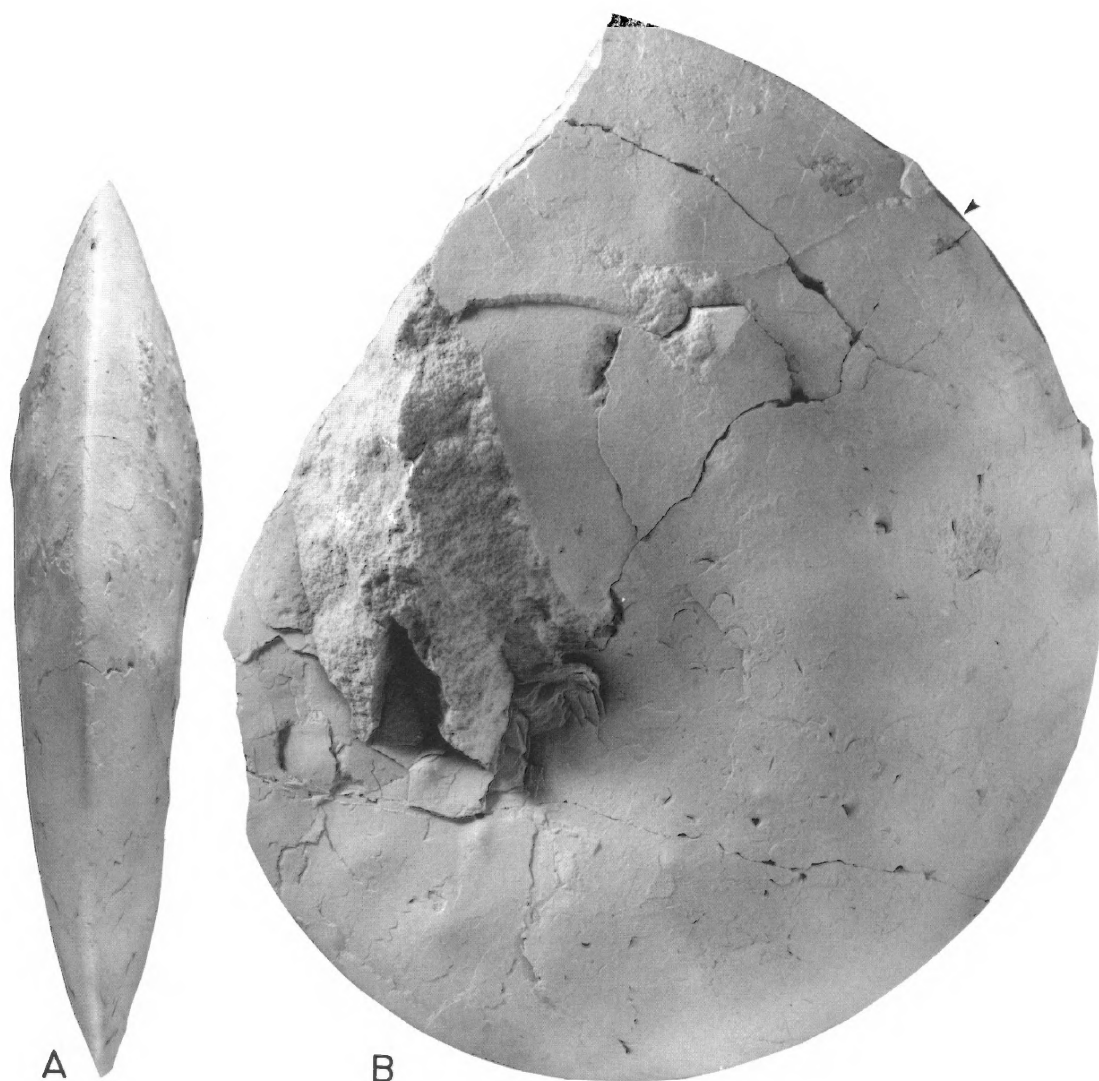


Fig. 6. *Sphenodiscus pleurisepta* (Conrad, 1857), USNM 486639, presumably a macroconch, USGS Mesozoic loc. 22116. A, Ventral; B, right lateral. All figures are reduced $\times 0.75$.

AMNH locality 3156, Fox Hills Formation, about 1 mi west of U.S. Highway 85 and about 5.5 mi south-southwest of Red Bird, Niobrara County, Wyoming.

AMNH locality 3214, Fox Hills Formation, bluffs along the south side of sec. 18, T37N, R62W, Niobrara County, Wyoming.

SYSTEMATIC PALEONTOLOGY

ORDER AMMONOIDEA ZITTEL, 1884

SUBORDER AMMONITINA HYATT, 1889

SUPERFAMILY ACANTHOCERATAEAE DE

GROSSOUVRE, 1894

FAMILY SPHENODISCIDAE HYATT, 1900

GENUS *COAHUILITES* BÖSE, 1928

TYPE SPECIES: *Coahuilites sheltoni* Böse, 1928: 283, pl. 13, figs. 4–11, by original designation.

Coahuilites sheltoni Böse, 1928

Figures 2, 3, 4B

Coahuilites sheltoni Böse, 1928: 283, pl. 13, figs. 4–11; Cobban and Kennedy, 1995: 12, figs. 2.8, 2.9, 7.1, 8.1–8.3 (with full synonymy).

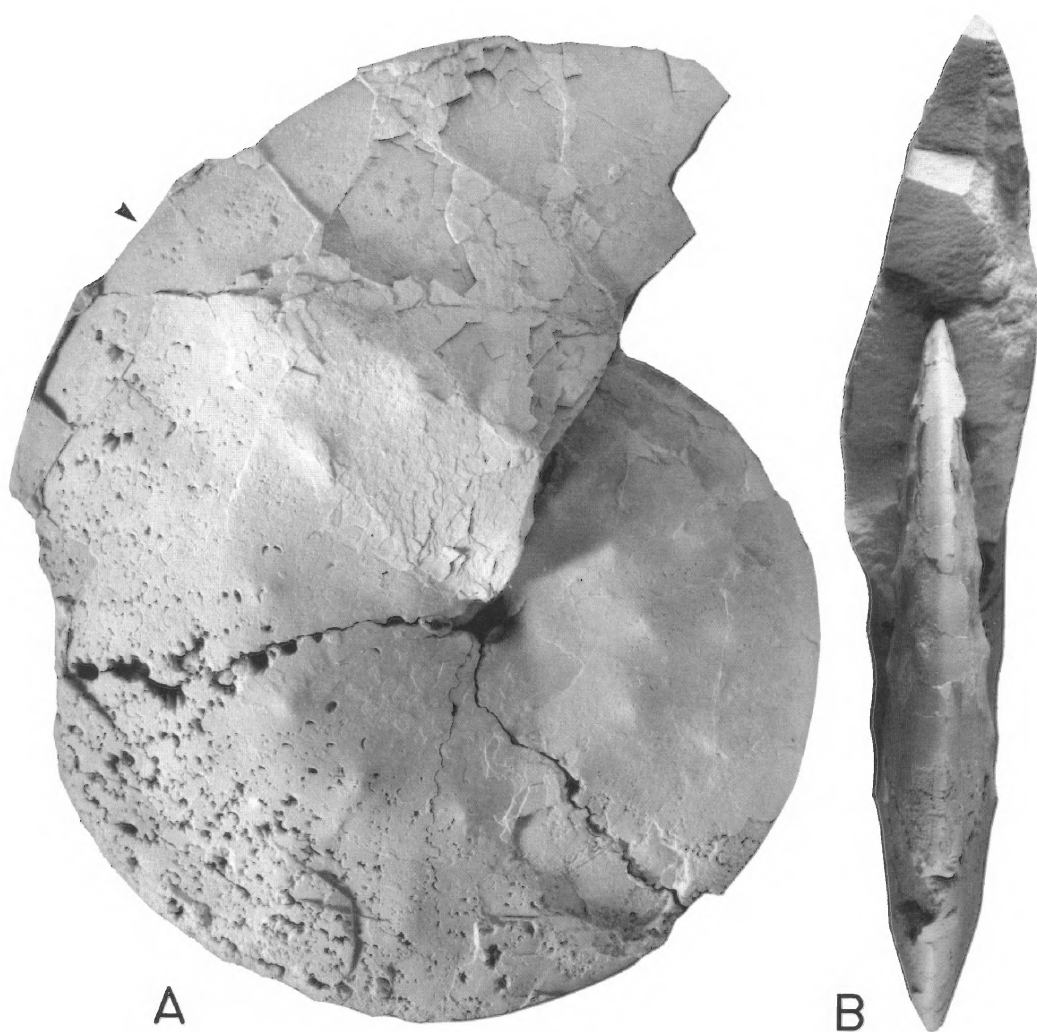


Fig. 7. *Sphenodiscus pleurisepta* (Conrad, 1857), AMNH 45341, AMNH loc. 3214. **A**, Left lateral; **B**, apertural. All figures are $\times 1$.

Coahuilites sp. Scott and Cobban, 1965, 1975, 1986a, b.

TYPE: Holotype, by original designation, is the original specimen of Böse, 1928: pl. 13, fig. 7, from the Escondido Formation about 3 mi south of Alamo Viejo in the region of Villa de Juarez, Coahuila, Mexico.

MATERIAL: Three specimens in the USNM Collections: USNM 32152 and 486636 from the Fox Hills Formation, Niobrara County, Wyoming, and USNM 76260 from the Miliken Sandstone Member of the Fox Hills Formation, sec. 6, T7N, R66W, Weld County, Colorado.

DESCRIPTION: USNM 76260 (fig. 2) is a slightly crushed individual 111 mm in diameter, with its original shell preserved. USNM 32152 (fig. 3) is a large, uncrushed internal mold 149 mm in diameter (table 1). Coiling is very involute in both specimens with a nearly occluded, tiny, crater-like umbilicus comprising only 4.2% of the diameter in USNM 76260 and only 7.6% of the diameter in USNM 32152. The whorl section is compressed with a whorl breadth to whorl height ratio of 0.50 in the uncrushed specimen. In this specimen, the umbilical shoulder is broadly rounded, the inner flanks are

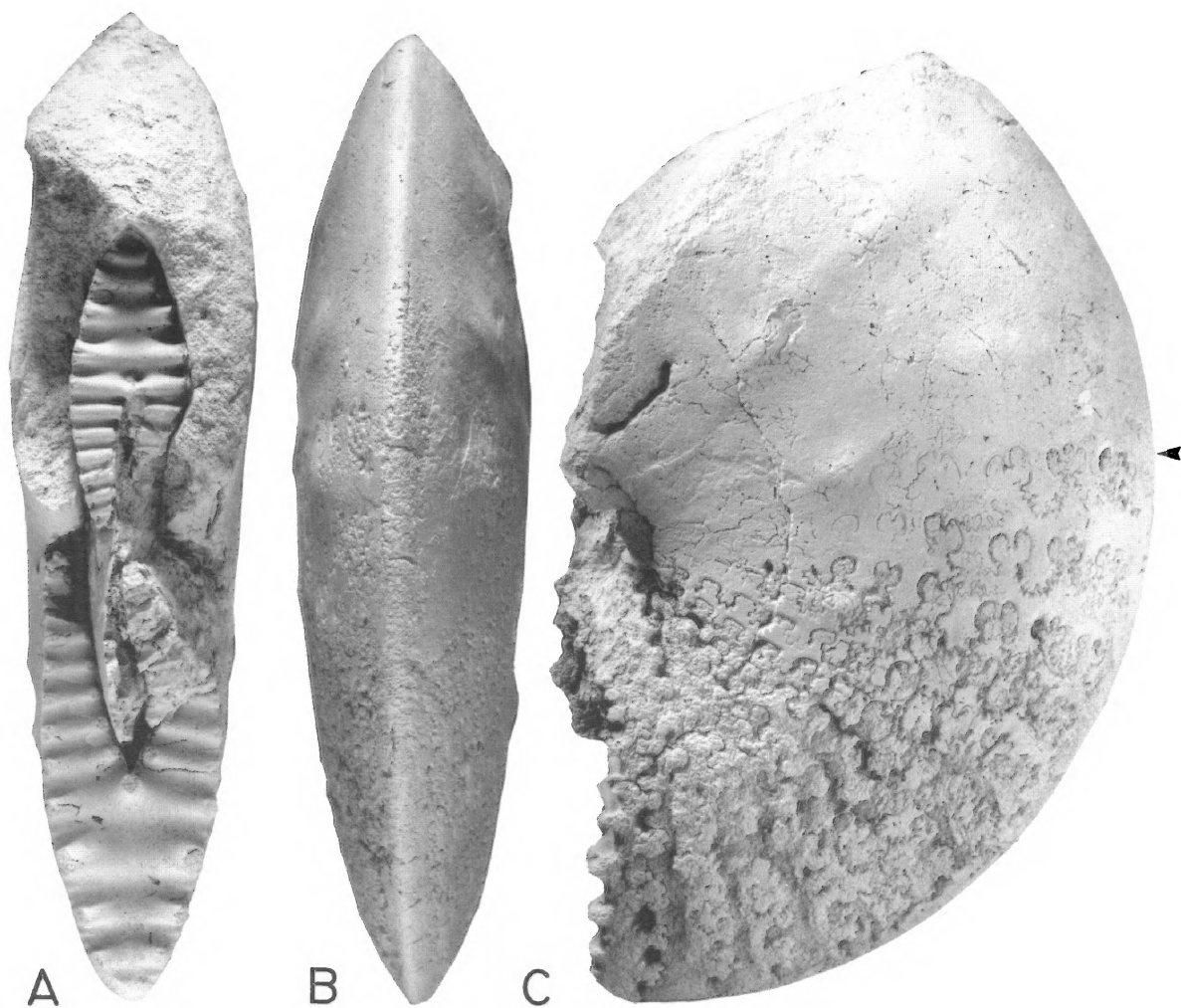


Fig. 8. *Sphenodiscus pleurisepta* (Conrad, 1857), AMNH 45342, AMNH loc. 3156. A, Apertural; B, ventral; C, right lateral. All figures are $\times 1$.

slightly concave and subparallel, and the outer flanks are weakly convergent. The ventrolateral shoulders are broadly rounded. The venter is obtusely fastigate on the phragmocone, becoming rounded with a blunt siphonal ridge on the adapical portion of the adult body chamber; this ridge weakens toward the adult aperture.

The shell surface of USNM 76260 is ornamented by delicate growth lines and striae. These are straight and prorsiradiate across the inner two-thirds of the flanks, and strengthen into distant, low radial ribs, approximately 16 per whorl, that bear small bullate or conical tubercles at mid-flank on the phragmocone. The tubercles migrate out to the junction of the

middle and outer thirds of the flanks on the adult body chamber (referred to below as mid-lateral tubercles or nodes). Ribs flex backward on the outer third of the flanks and then forward, crossing the venter with a broad convexity. On the phragmocone these ribs strengthen into short, crescentic bullae on the outermost flanks and ventrolateral margin. These bullae efface progressively in an adoral direction on the adult body chamber.

USNM 32152 (fig. 3) has 11 mid-lateral nodes on the last whorl. These are strong on the phragmocone but weaken on the adult body chamber, extending almost to the adult aperture. The ventrolateral ornament shows a similar decline.

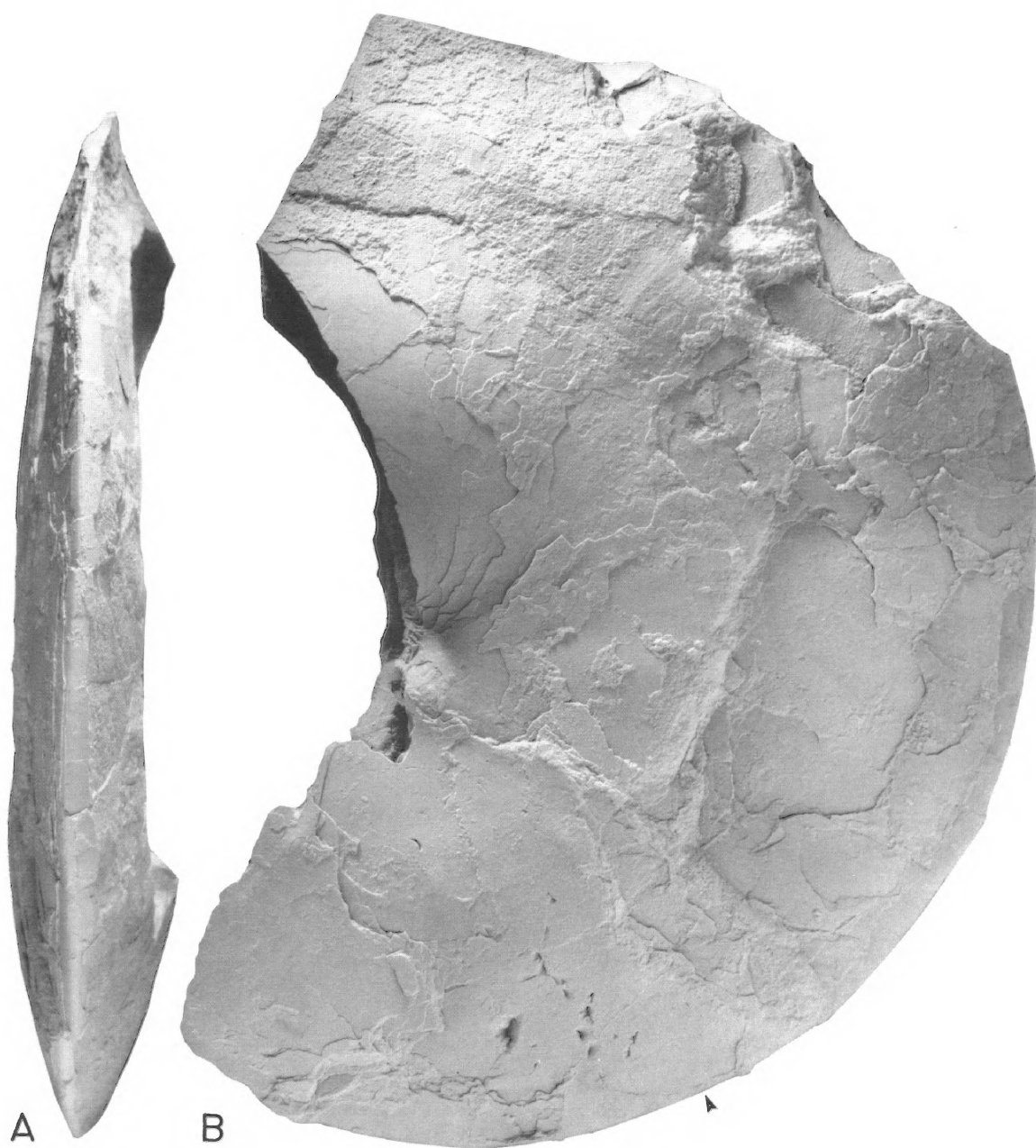


Fig. 9. *Sphenodiscus pleurisepta* (Conrad, 1857), USNM 486637, presumably a macroconch, USGS Mesozoic loc. 5981. A, Ventral; B, right lateral. All figures are $\times 0.85$.

What appears to be a part of the inner whorls of a larger specimen is represented by USNM 486636 (not illustrated), a crushed fragment with a maximum preserved whorl height of 41.7 mm and a whorl breadth to height ratio of 0.46. The venter is obtusely fastigate. The inner flanks are

markedly concave. Mid-lateral tubercles are bullate and equal in number to prominent ventrolateral clavi. There is, thus, an ontogenetic change from ventrolateral clavi in early ontogeny to ventrolateral bullae at the end of the adult phragmocone, reducing to low, radial crescentic ribs on the outermost

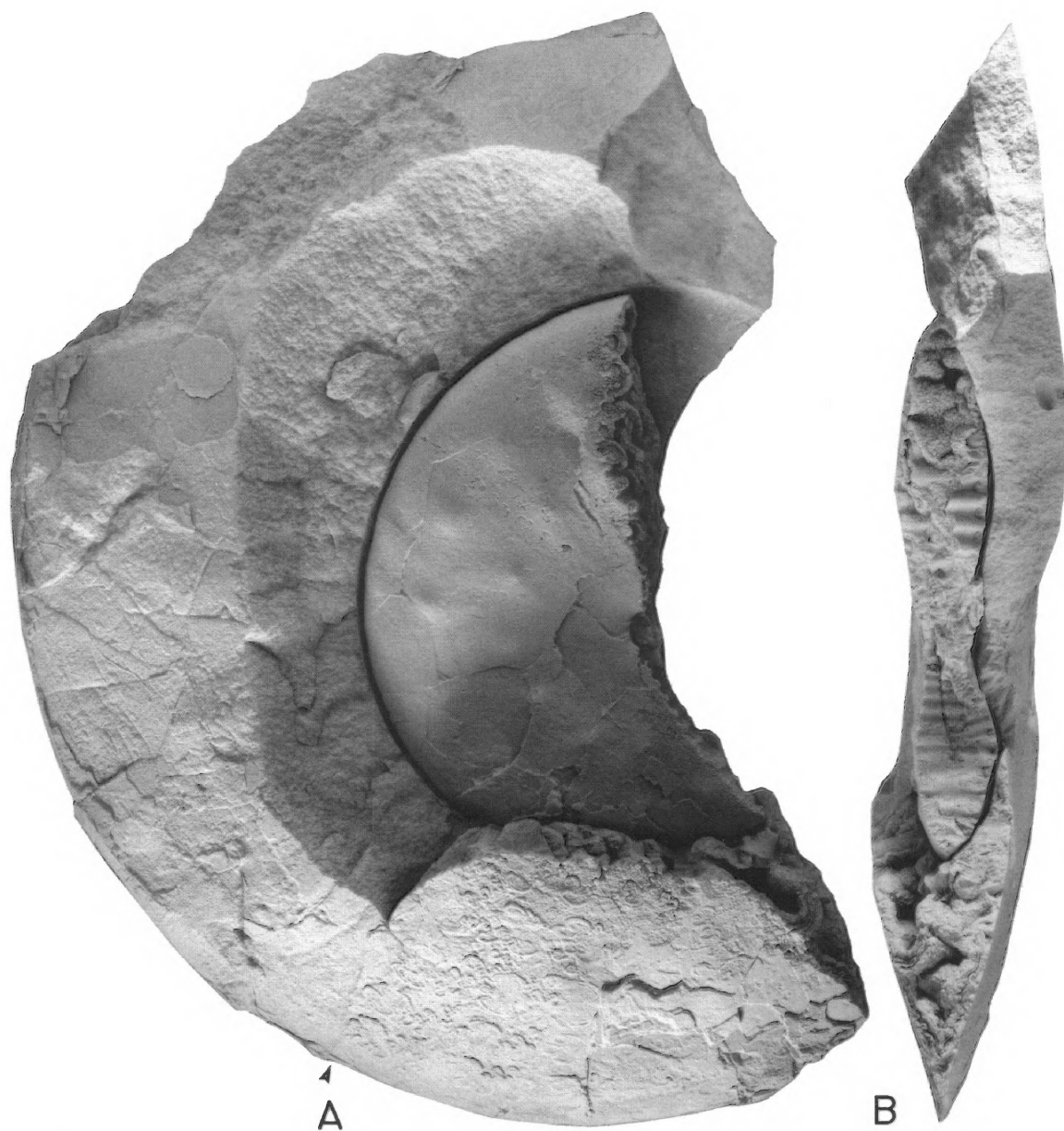


Fig. 10. *Sphenodiscus pleurisepta* (Conrad, 1857), specimen in fig. 9. **A**, Left lateral; **B**, apertural. All figures are $\times 0.85$.

flanks and ventrolateral portion of the adult body chamber.

The suture (fig. 4B) has a very broad and shallow E with a broad, low, little incised median saddle; E/L is subdivided into two by a broad, moderately incised adventive lobe; the adjacent saddles have entire terminations. There are at least six auxiliary saddles, all of which are entire, with adjacent lobes becom-

ing progressively less incised toward the umbilicus. The suture shows a marked ontogenetic increase in the degree of incision in both adventive lobes and saddles and auxiliary saddles.

DISCUSSION: Cobban and Kennedy (1995) revised *Coahuilites sheltoni* and examined numerous specimens from the Escondido Formation of Trans-Pecos Texas and north-

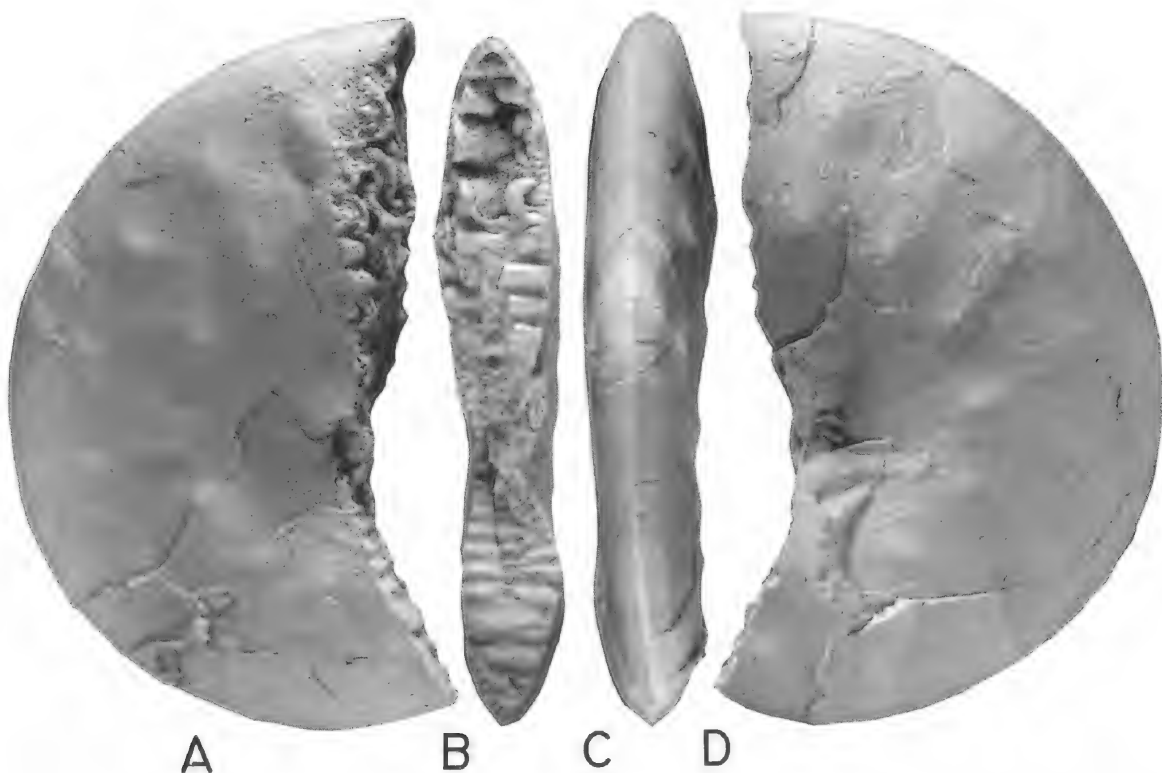


Fig. 11. *Sphenodiscus pleurisepta* (Conrad, 1857), inner whorls of specimen in fig. 9. A, Left lateral; B, apertural; C, ventral; D, right lateral. All figures are $\times 1$.

ern Mexico. They concluded that the three *Coahuilites* species described by Böse (1928), *C. sheltoni*, *C. orynskii*, and *C. cavinsi* were conspecific, and selected the name *sheltoni* for the species. *Coahuilites bassae* Cantu Chapa, 1963 (p. 64, pl. 8, fig. 5, text-fig. 5), and *C. obregoni* Cantu Chapa, 1963 (p. 63, pl. 7, fig. 6; pl. 8, fig. 4; text-fig. 4), both based on juvenile specimens and differentiated on sutural characteristics, are probably synonyms of a variable *C. sheltoni*.

OCCURRENCE: *Coahuilites sheltoni* is restricted to the *Hoploscaphites birkelundi* zone in the Western Interior (fig. 1), with records from the Fox Hills Formation near Red Bird, Niobrara County, Wyoming, and the Milliken Sandstone Member of the Fox Hills Formation, Weld County, Colorado. The species also occurs in the Escondido Formation of Trans-Pecos Texas and northern Mexico, and in the Prairie Bluff Chalk in Mississippi and Alabama.

GENUS *SPHENODISCUS* MEEK, 1871

TYPE SPECIES: *Ammonites lenticularis* Owen, 1852: 579 (*non* Young and Bird, 1928: 269, fig. 5), by original designation, = *Ammonites lobata* Tuomey, 1856: 168.

Sphenodiscus pleurisepta (Conrad, 1857) Figures 4A, 5–12

Ammonites pleurisepta Conrad, 1857: 159, pl. 15, fig. 1.

Sphenodiscus pleurisepta (Conrad, 1857). Cobban and Kennedy, 1995: 12, fig. 8.5 (with full synonymy).

Sphenodiscus lenticularis (Owen). Kellum, 1962: 68, pl. 4, figs. 3, 4; pl. 5, fig. 1; pl. 6, figs. 1, 2.

TYPE: The holotype is USNM 9888, said to be from "Jacun, 3 miles below Laredo," but probably from the Escondido Formation of the Rio Grande Region, probably in Maverick County, Texas (Stephenson, 1941, 1955).

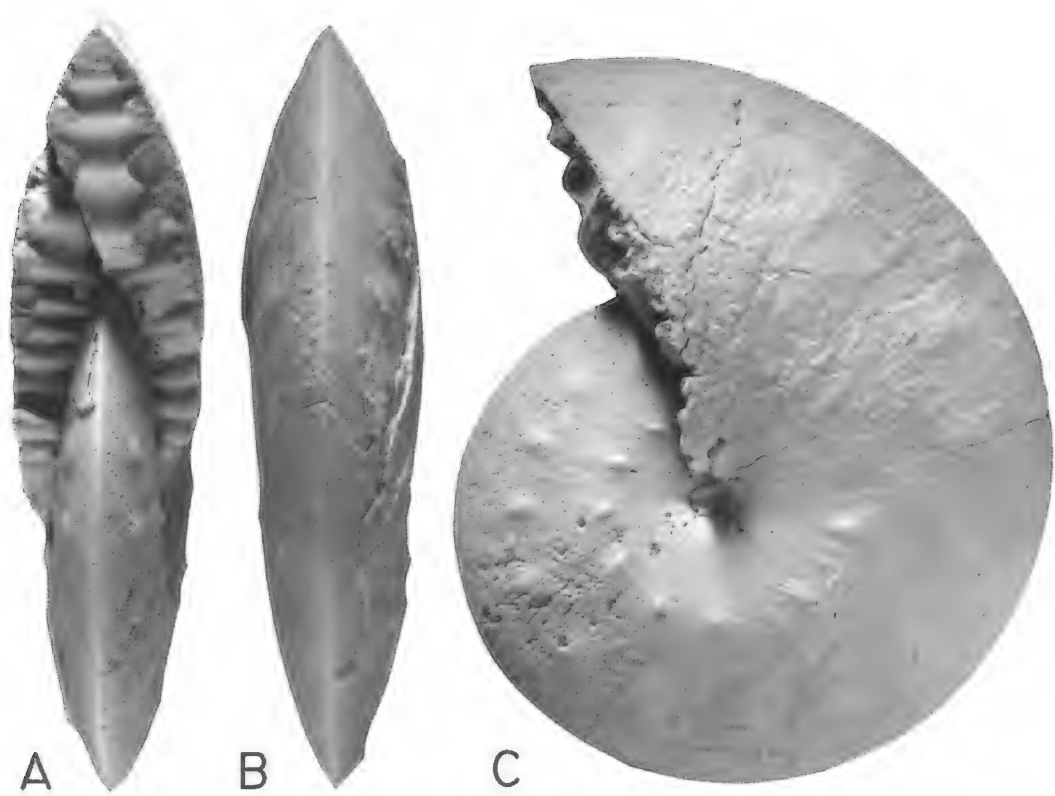


Fig. 12. *Sphenodiscus pleurisepta* (Conrad, 1857), BHI 2037 from 1 mi north of the mouth of Elk Creek, in the N½ sec 36, T14E, R4N, Meade County, South Dakota. **A**, Apertural; **B**, ventral; **C**, right lateral. All figures are ×1.

MATERIAL: Eight specimens: AMNH 45341 from AMNH loc. 3214; AMNH 45342 from AMNH loc. 3156; BHI 2037 from 1 mi north of the mouth of Elk Creek, in the N½ sec. 36, R14E, T4N, Meade County, South Dakota; USNM 486637 from USGS Mesozoic loc. 5981; USNM 486638 and 486639 from USGS Mesozoic loc. 22116; USNM 486640 from USGS Meso-

zoic loc. D12236; and USNM 486641 from USGS Mesozoic loc. D1049.

DESCRIPTION: Dimensions of four of the specimens studied are listed in table 2. The shell is oxyconic, with a very compressed whorl section and minute umbilicus. The innermost flanks are markedly concave, the mid-flank region is slightly convex, the outer flanks are flattened and convergent, and the

TABLE 2
Dimensions (mm) of *Sphenodiscus pleurisepta* (Conrad, 1857)^a

Specimen	D	Wb	Wh	Wb:Wh	U
USNM 486637 ^b	92.2 (100)	16.5 (17.9)	51.4 (55.7)	0.32	5.2 (5.6)
USNM 486639	190.7 (100)	41.6 (21.8)	111.6 (58.5)	0.37	— (—)
AMNH 45341	131.1 (100)	25.2 (19.2)	74.2 (56.6)	0.34	5.8 (4.4)
BHI 2037	98.4 (100)	22.6 (23.0)	57.1 (58.0)	0.40	5.4 (5.5)

^a Figures in parentheses are dimensions as a percentage of diameter.

^b Measurements are based on a portion of the inner whorls (fig. 10).

venter is acute. When well-preserved, the shell surface is covered by dense, crowded, falcoid growth lines and striae. These are straight on the inner flank, convex on the mid-flank, and concave on the outer flank. They then sweep forward to intersect the line of the venter at an acute angle. These growth lines and striae are generally invisible on internal molds. A row of weak mid-lateral bullae, seven per half whorl, marks the boundary between the concave inner and convex mid-flank regions. A second row of blunt, weak bullae occurs on the outer flanks. These bullae alternate with those of the mid-lateral row, to which they may be linked by low ribs. Faint, crescentic ribs extend across the ventrolateral shoulder. Only the mid-lateral row of bullae persists onto the adult body chamber; the outer lateral row declines, developing into low crescentic ribs.

The suture (fig. 4A) has narrow-stemmed saddles and up to ten auxiliary elements on the umbilical lobe.

DISCUSSION: Although we have relatively few complete adults, the present material may be dimorphic. USNM 486640 shows a broadening of the venter of the body chamber and may be a nearly complete adult at 134 mm diameter: it is presumably a microconch (fig. 5). USNM 486639 is an adult at more than 200 mm diameter (this estimate includes the missing part of the body chamber), and is presumably a macroconch (fig. 6).

The presence of two rows of nodes on the

flanks serves to distinguish *S. pleurisepta* from the widely occurring *S. lobatus*; see Cobban and Kennedy (1995) for a discussion of the synonyms of the present species and differences from other species referred to this genus.

OCCURRENCE: *Hoploscaphites birkelundi* zone, Pierre Shale, Meade and Pennington counties, South Dakota; *H. birkelundi* zone, Fox Hills Formation, Niobrara County, Wyoming and Weld County, Colorado (fig. 1). The species is also known from the Escondido Formation in Trans-Pecos Texas and northern Mexico, the Corsicana Formation in northeast Texas, the Owl Creek Formation in Missouri, Mississippi, and Tennessee, the Prairie Bluff Chalk in Mississippi, and the Severn Formation in Maryland.

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